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REVITALIZING the MAINE SUGAR BEET INDUSTRY

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PREFACE

This study examines the potential for utilizing the existing but idle sugar plant in Easton, Maine. It is concerned with (1) the problems of sugar beet production, (2) costs and returns for operating the sugar beet plant, and (3) alternative organizational structures for operating the plant.

This work was undertaken at the request of representatives of the Maine Sugar Beet Growers Association and the Governor's Task Force to Preserve the Maine Sugar Beet Industry. The request was supported by government officials and agricultural business leaders.

This report briefly reviews pertinent developments in the Maine sugar beet industry, updates critical data, and analyzes the options confronting farmers who might be served by the present facility.

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HIGHLIGHTS

The outlook for sugar beets in Maine is good if production problems can be overcome. These problems went unsolved during 1966-69 because of inadequacies of the Maine Sugar Industries (MSI) agricultural management program, and growers' inexperience with the technology of sugar beet production.

Naturally acid soils, weeds, a short growing season, growers' unfamiliarity with small-seeded row crops, and fundamental conflicts between potato and sugar beet production resulted in poor yields. The solution to these problems includes liming to reduce soil acidity, using recommended herbicides, early planting to extend the growing season, the reordering of growers' priorities, and strict adherence to recommended production practices. There has been little commercial-scale experience with presently recommended and recently developed production practices.

The Easton refinery, now idle and owned by the State of Maine, has processing capabilities for both raw cane sugar and sugar beets, but the ultimate feasibility of its operation will depend heavily on growers being able to profitably produce beets. Income from refining sugar beets is estimated at 2 to 3 times that from refining raw cane sugar.

Costs for raw product and marketing of refined sugars are a substantial part of total costs, with estimates ranging upward of 70 percent of sales. Costs of special concern to potential refinery purchasers include investment and renovation, transportation of raw product and refined sugar, and marketing, especially market entry.

Either a cooperative or a proprietary organization could be formed to reestablish the refinery as a going business organization. A cooperative could provide growers the opportunity to further profit from the processing and marketing of their sugar beets. A proprietary organization, either a partnership or a corporation, would operate in the interest of the partners or stockholders, but would bear the financial and management responsibilities that growers would have to assume should they form a cooperative.

To gain the cooperation and good will of growers, a proprietary organization should work with the Maine Sugar Beet Growers Association (MSBGA), a local sugar beet bargaining cooperative that represented growers in developing a marketing contract with MSI. MSBGA has the confidence of growers and is structured to work effectively with a processor.

RECOMMENDATIONS

1. Every effort should be made to achieve strict adherence to recommended production practices.

   a. Growers should be committed to devoting adequate time and attention to the best production practices and to carrying out these practices on a scheduled or timely basis.

   b. The processor should provide highly qualified agricultural representatives to advise growers on production practices, scheduling of operations, and related problems. These representatives should be free of all other responsibilities, such as sales of processor's fertilizer and chemical supplies.

   c. The processor-grower contract should spell out processor's obligations to provide advisory services and growers' obligations to perform specific operations on a scheduled basis. Penalties for nonperformance may be in order.

2. A number of demonstration plots of commercial-scale should be planned for the 1974 season. Many uncertainties in the Maine sugar beet situation stem from growers' lack of knowledge and experience in beet production, particularly with respect to currently recommended production practices showing promise for improved yields. Although agronomists, researchers, and some farmers can vouch for the effectiveness of these practices in obtaining satisfactory yields, many growers are not fully aware of the necessity of adopting these measures.

   To dispel any doubts in the minds of growers, all agencies interested in the future of the sugar beet industry in Maine should join in making possible a group of commercial-scale demonstrations during the 1974 season. These would require the use of carefully chosen plots in various areas of Aroostook County where sugar beets could be grown to demonstrate the adequacy of presently recommended practices, including liming rates, early planting, newly recommended seed, planting to a stand, and weed control using herbicides. Number and size of plots should be determined by the interested agencies. Emphasis should be placed on demonstrating what good production practices can do to produce sugar beets under conditions approximating commercial production. Yields of beets and sugar content would be the final proof of effectiveness.

   Two advantages would result from these demonstrations. One, growers would have an opportunity to observe the recommended practices and see the results. Two, any buyer, prospective buyer, or possibly new owners or operators of the sugar beet factory would share growers' interest in this demonstration and be even more interested in results. Conditions, treatments, and results should be publicized in detail and all interested parties should be urged to observe the plots to any extent that would not interfere with production.

A demonstration in 1974 might possibly come at a time of continuing uncertainty in the sugar beet situation. However, a successful demonstration that will show recommended production practices producing adequate yields of sugar beets would serve to remove much of any existing uncertainty. It might very well stabilize the situation by proving that sugar beets can profitably be produced in Maine and thus the sugar factory would be a good investment.

The costs of such a demonstration program should not be excessive. Out-of-pocket costs for seed, lime, fertilizer, herbicides, gasoline, supplies, repairs, and farm labor are roughly estimated at $200 per acre. This does not include any use of land, machinery, professional services, or any indirect costs. Monetary returns for beets produced would be minimal if no processing facility is within a reasonable distance.

3. A general educational program on sugar beet production should be planned for growers and made ready for use on short notice in the event the sugar factory should once again become operational.

4. Careful consideration should be given to the alternative of single-cropping sugar beets for perhaps as long as 4 to 5 years. Based on a recommended initial application of 5 tons of lime for soil with a pH of 5.0, first-year costs are estimated at $67 to $83, depending on the source of lime. Second and third year lime costs would be much reduced and the residual effect of lime applied in the first year would be realized by beets rather than by another crop. Also, potato scab would not be an immediate problem with a single-cropping plan.

5. Plans should be readied for making the State-owned specialized beet machinery available to growers on an effective basis, should production resume. High costs of machinery and problems with custom operations, particularly scheduling work, should give such planning high priority.

6. An effort should be made to encourage growers and the general public to understand the cost relationships involved in refining sugar. An understanding of these costs will promote better grower-processor relationships and develop public appreciation for the refinery's contributions to the local economy.

7. No effort should be made at this time to organize a cooperative for acquiring and operating the Easton refinery. The feasibility of growing beets is unsettled in the minds of many growers. As a result, growers generally lack interest in forming a cooperative and no possibility is seen for growers raising the amount of equity capital necessary for funding such an organization.

8. Growers should support the Maine Sugar Beet Growers Association (MSBGA) as their representative in community efforts to encourage revitalization of the Easton refinery. Once the plant has been reactivated, MSBGA will play an important role in representing growers' interests with the new processing organization.

REVITALIZING THE MAINE SUGAR BEET INDUSTRY

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INTRODUCTION--EARLY MAINE SUGAR BEET INDUSTRY

Changing demand and supply conditions for sugar that emerged in the 1950's encouraged economic development interests in Maine to consider the potential for sugar beet production in what is essentially the one-crop potato agriculture of Aroostook County. This interest produced a number of economic and engineering studies during the early 1960's, all encouraged by relatively easy access to Boston and New England sugar markets that are characterized by relatively high prices and few sugar refineries.

In 1964, the Great Western Sugar Company was committed to building a sugar factory in Aroostook County, and participated in requesting the U.S. Department of Agriculture to grant a sugar beet allotment for that production area. Some time after that allotment had been granted, Great Western reversed its decision and left Aroostook County on the premise that agronomic problems of sugar beet production in Maine were unresolved.

In the latter part of 1964, Maine Sugar Industries, Inc. (MSI), a public company, was formed under the leadership of the Vahlsing family, with F. H. Vahlsing, Jr., as president and chairman of the board. Financing for the enterprise came from a variety of development agencies, banks, and private citizens, including Aroostook County farmers, to the extent of an estimated total of $1 million. The State of Maine guaranteed some of the bank loans and thus became an active supporter of the development.

MSI contracted for the construction of a sugar beet plant at Easton, Maine, with a daily input capacity of 4,000 tons and with equipment for handling 700 tons of raw cane sugar daily in the off-beet season. This plant, built adjacent to the Vahlsing potato plant, operated from 1966 to 1969, during which time growers supplied beets as follows:

Year	Acres planted	Acres harvested	Tons of beets produced	Average tons harvested per acre	Sucrose content of beets
	1,000	1,000	1,000		Percent
1966	3.4	3.3	17	5.3	17.3
1967	9.6	8.0	76	9.5	15.6
1968	25.5	22.2	111	5.0	16.2
1969	12.5	10.8	69	6.4	16.8

Total farm production and average yield per acre on a commercial basis did not measure up to expectations. Planting reached 25,500 acres in 1968 after a massive drive failed to reach the assigned allotment of 33,000 acres. This drive brought into production land unsuited for sugar beets and added to the already difficult problems of poor yield caused by inadequate and unsuitable cultural practices. Although growers learned much more about the production of sugar beets, some problems such as weed control had no reasonable solution until 1969--the last year of production--and others still remained to be dealt with.

As a result, the MSI plant did not operate on an efficient basis and experienced financial difficulties. Apparently, because of financial problems, raw cane sugar used to supplement plant operations was available to the plant only in relatively small quantities.

MSI management has been critized on many scores. A particular problem for growers was the failure of payments for beets to be made on schedule; and in 1969, the last year of the plant's operation, growers were not fully paid for deliveries. However, in 1973, a substantial part of the money due on these deliveries was finally paid to growers.

Through foreclosure proceedings, the State of Maine has come into possession of the sugar beet facility and production equipment such as planters, cultivators, and harvesters formerly owned by MSI. Officials are concerned with recovering State funds tied up in the plant and with finding a use for the facility that will serve the best interests of citizens of Aroostook County and the State of Maine.

Because this sugar factory is a highly specialized plant, its potential as an income-producing property depends primarily on its producing refined sugar from beets. Any future operation will depend on an involved combination of circumstances and conditions, but the potential for producing sugar beets in the area surrounding the plant will be a prime consideration.

SUGAR BEET PRODUCTION IN MAINE

Sugar beet production in Maine during 1966-69 was largely confined to Aroostook County. Some beets were also produced in counties in central and western Maine, with more than 10 percent of the harvest coming from these areas in some years. However, this report views sugar beet production in Maine as being limited primarily by conditions found in Aroostook County, but recognizes that production potential in other areas may in some instances be very favorable.

Climate

Aroostook County has a cool climate, favorable to potato and sugar beet production. Annual precipitation averages 35.4 inches, with about 20.7 inches distributed uniformly throughout the May-October grower season.

The frost-free period is about 120 days, which is rather short. Furthermore, there is a 1 in 3 chance of 32°F. temperatures occurring as late as May 24 and as early as September 16 in Caribou.

The short frost-free period is somewhat offset by the reasonably warm long days and cool nights of the growing season. Although this combination is favorable for the production of plant tissue, summer temperatures in Aroostook County average 64°F., or about 6°F. less than the suggested ideal.

Although length of growing season is one of the important conditions limiting sugar beet production in Aroostook County, planting no later than May 20 and starting harvest by October 1 can provide a growing season of 150 days, with an average closer to 120 days. Most sugar beet areas in the United States have a 150-day minimum season.

Soils

Sugar beets require deep, well-drained, permeable soils, with good moisture-holding capacity. Roots penetrate well and benefit from deep soil with good tilth.

Two soil conditions found in Aroostook County present problems--stones and soil acidity. Course material may be beneficial to soil structure, but rocks have presented problems in harvesting. Poor cultural practices produced many acres of small beets. Adjusting harvesters to lift small beets has resulted in a substantial pickup of rocks. The stone problem has been further aggravated by badly frosted or frozen ground when harvest was unduly delayed. Good cultural practices would eliminate most, if not all, of the stone problem in beets. Stones can be removed from fields using rock picking equipment available in the area, and modern potato harvesting equipment separates rocks from tubers, depositing the stones in piles for removal from the fields. Land formerly used for potatoes presents significantly fewer rock problems for sugar beet growers.

Acid soil is probably the most important condition limiting sugar-beet production in Aroostook County. Sugar beets require soil with a pH of 6.0 or more [1]. 1/ Both research and experience with commercial production in Maine emphasize the need for a suitable pH level.

Experiment station records on soil samples from Aroostook County show an average pH of 5.01 in 1958 and 4.99 in 1968 [5]. With a pH below 5.5, beet plantings show poor emergence, and plants that do emerge are likely to die during the growing season. It is predicted that beet yields can be doubled by raising the pH from 5.0 to 6.0 [5].

1/ Underscored numbers in brackets refer to items in the literature cited.

Low pH levels can be corrected with the application of lime. One ton of lime to the acre will raise the pH level about 0.2. At this rate, it would take 5 tons to bring the pH level in an area from 5.0 to 6.0.

Land Availability

More than 25,000 acres in Maine were planted to sugar beets in 1968--about 92 percent in Aroostook County. Some of this land was unsuited for sugar beets because it had not recently been cultivated, was weed infested, unduly rocky, and, in most cases, acid. Most, if not all, of these conditions could be corrected with proper cultural practices.

If the industry is to operate at capacity, it will ultimately require production of up to 40,000 acres, yielding at least 15 tons to the acre. According to the U.S. Census of Agriculture for 1969, Aroostook County has 560,995 acres of land in farms, about half in cropland. Potatoes accounted for 143,560 acres; small grains, 28,000 acres; hay, 20,770 acres; vegetables, 8,670 acres; and other crops, 10,460 acres.

Sugar beets can be grown on much of this land, and would most likely replace the small grains now in rotation with potatoes. Some of the potatoes, oats, hay, and other vegetables might be replaced by sugar beets, if growers find beets a comparatively profitable crop. Retired cropland could be planted to beets, with proper precautions to insure good production practices, especially weed control.

Production Technology

Commercial production of sugar beets in Maine was handicapped at the outset by an inadequate understanding of the required production technology. Other investigators have concluded that MSI had little or no experience in sugar production and its agricultural management staff was not organized to provide growers the technical direction they needed to become successful sugar beet producers. The Cooperative Extension Service also lacked experience in dealing with the practical problems of sugar beet production. Farmers in Aroostook County are primarily potato growers, and although potatoes and sugar beets are both row crops, similarities about end on that point. Sugar beet production requires not only new methods, but also new thinking and new understanding.

The application of a new technology was further complicated by the great urgency to get a substantial acreage planted to beets to protect the USDA acreage allotment for the area. For instance, in the rush to get production started, land was used regardless of its suitability for sugar beets. The need for large quantities of lime was not immediately recognized and growers concerned about its cost and adverse effect on potatoes were reluctant to make the recommended applications. Weed control in the first years of sugar

beet production was inadequate. Many potato growers were unaware of the requirements for early and close mechanical cultivation of beets and weeding was sometimes delayed, causing very difficult problems later.

Chemical weed control was being adapted to Maine sugar beets during most of 1966-69. Herbicides recommended early in this period were not fully effective, and it was not until 1969 that chemicals appeared to be a reasonable alternative to mechanical weed control. Chemicals are now available that provide effective weed control in sugar beets grown in Maine.

Like weed control, other production technology has continued to develop. Seeding to a final stand is now recommended and will make possible the elimination of thinning. Taken together, effective weed control and seeding to a stand virtually eliminate hand labor in beet production, a significant step for producers facing a growing scarcity of labor.

Some growers have experimented with transplanting sugar beets and some interest has been expressed in larger scale plantings. Several advantages have been cited for encouraging the practice, but the most significant for Maine would be the possibility for lengthening the growing season, which in turn would increase yields.

This practice was discussed in a presentation to the Legislative Research Committee [5]. It was noted that the practice has had no commercial application except in Japan, where increased yields were achieved, but with a rather high labor input. Limited university experiments show significant yield increases with transplants, but it was assumed that costs were more than offsetting.

When the costs of growing plants, transportation, planting, and possibly special irrigation requirements were all considered, transplanting could only be economic with very substantial yield increases. Furthermore, plants grown in other areas pose the threat of disease and weed introduction. Any future consideration of using sugar-beet transplants should include an appraisal of all these problems, but especially the economics of transplanting over 30,000 acres.

Production Conflicts

The original interest in sugar beets for Aroostook County was spurred on by an avowed need for a second cash crop. Growers and community leaders remain very conscious of the need for a second crop, but whatever that crop may be, its competitive position relative to potatoes must be clearly recognized. Sugar beets, for instance, did not in many instances compete effectively for farmers' time and attention. Given a choice, farmers were more apt to work on potatoes than beets. This made beets a second-class crop rather than a second crop. Such a position could be justified in many ways. For most farmers, beets presented new problems in seeding, cultivating, weeding, thinning,

harvesting, and marketing. Solutions to these problems were not easy or readily available, and the profits for beets were in fact uncertain, if they existed at all.

However, some production operations for sugar beets, such as planting, require an equal priority with potatoes. Failure to get beets planted as soon as possible, shortened the already short crop season. Other examples in cultivating and harvesting operations could be cited to illustrate the farmer's difficult decisions if he is to be a successful sugar beet producer. He must think sugar beet just as he thinks potatoes.

A further and very serious conflict can exist if a grower is to correct soil acidity and raise soil pH levels above 5.0. Sugar beets and scab-susceptible round potato varieties do not fit well in the same rotation. Sugar beets require at least a soil pH of 6.0 and round potato varieties are scab-susceptible at pH levels between 5.0 and 6.0.

Russet potato varieties, however, are not affected by scab at levels below a pH of 6.0. Yet, many growers are apprehensive about using the required amount of lime necessary to grow beets, either because they plant round varieties or anticipate doing so at some time in future rotations.

Beets Improve Potatoes

Where sugar beets have been grown in rotation with Russet potatoes, observers have claimed increased yields and improvement in potato quality. Growers, processors, and Extension Service personnel have reported substantial increases up to 25 barrels per acre. Also, it is claimed that quality, with respect to tuber confirmation, or appearance, has been improved. The deep massive root system of sugar beets and the plowing in of tops have been credited with the improvement.

Trials conducted by experiment station personnel do not confirm these yield observations. Tuber appearance was not considered in these tests, but internal quality and yield showed no improvement over potatoes grown in a non-sugar beet rotation.

Yields, 1966-69

Any consideration of sugar beet production must eventually come down to the matter of yields. As pointed out, average yields during 1966-69 were disappointing. Tons per harvested acre averaged between 5.0 and 6.4 in the 1966, 1968, and 1969 seasons. Only in 1967, with a 9.5-ton average per harvested acre were yields considered encouraging, but far short of the national average of 17.2 tons. However, 1967 yields were close to the break-even mark, assuming 1963 estimated costs. Sugar content of beets produced was good, averaging 15.6 to 17.8 percent over the four seasons. This is considerably

above the national average, which was consistently under 14 percent during the entire period.

An examination of yields on individual farms showed very few farmers averaging more than 9 tons of beets to the harvested acre in 1966. In 1967, a few growers exceeded 18 tons to the acre. In 1968, 15 tons were about the limit, and in 1969, with less than half the number of 1968 farms involved, individual yields were back to about the 1966 level (table 1).

Table 1--Sugar beet yields--percent of farms harvesting and acreage of sugar beets harvested at various average yields, Aroostook County, Maine, 1966-69

Average yield per acre	1966		1967		1968		1969	
	Farms	Acres	Farms	Acres	Farms	Acres	Farms	Acres
Tons				Percent				
18 or more			2.3	0.8				
16 or more			5.4	2.6				
14 or more			11.5	8.6	0.8	0.2		
12 or more	0.8	0.7	24.6	32.2	3.7	1.3	0.9	0.2
10 or more	1.6	0.9	42.3	49.0	7.8	3.1	2.8	0.8
8 or more	4.9	4.6	66.5	69.5	19.2	11.8	13.8	10.4
6 or more	33.6	44.8	86.9	91.6	49.0	31.7	50.5	35.2
4 or more	73.8	86.2	97.7	98.7	73.9	43.6	78.0	86.6
Total production	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
				Number				
Total farms harvesting	122		260		245		109	
Total acres harvested		3,012		6,354		20,447		8,388

Another way of examining yields is on an acreage rather than a farm basis. Only in 1967 were there any yields of more than 18 tons per acre. Almost half the acreage produced yields averaging 10 or more tons and 69 percent had 8 or more tons. In all three other seasons, the acreage yielding 8 or more tons varied from 5 to 12 percent.

Although no analysis was made of yields on farms in other counties, evidence shows that yields in these other areas were generally better than those for Aroostook County.

Potential Yields

Potential yields will depend on growers' abilities to overcome production problems, especially low soil pH, short growing season, and excessive weeds. Unfortunately, we know all too little about potential yields and the 1966-69 experience is not encouraging. However, it must be remembered that much of what was learned about sugar beet production practices during that period was not tested on any large scale.

For instance, the Monohill sugar beet variety, introduced late in this period, was still undergoing trials in 1971. It was reported in a paper presented to the Legislative Research Committee:

> The variety Monohill from Hilleshog of Sweden looks even better and yielded over 18 tons per acre in our 1971 variety trial [5].

Although one must be careful not to assume these trials are the equivalent of commercial-scale production, they suggest reasonable commercial yields to be possible.

The most limiting production problem is undoubtedly soil pH, and is the only problem for which any estimate of effect on yield has been risked. In the presentation to the Legislative Research Committee, it is also pointed out:

> Examination of the 1965-68 yield curve shows that on fields testing pH 5.0 or so one should expect a yield of "6.5" tons per acre. This agreement of the industry experience with the research data certainly reinforces our research data. The very practical prediction that one may make for these data is that the yield of sugar beets in Aroostook County can be doubled by raising the pH from 5.0 to over 6.0. It also seems to me that doubling the reported yields of "6.5" tons per acre to 13 tons per acre would be one giant step ahead for the farmers of Aroostook County [5].

Correction of pH levels to attain adequate yields is given much emphasis, but acceptance of all the other recommended production practices is also necessary. Inadequacies in weed-control practices and production scheduling have known remedies that will contribute substantially to improved yields. The acceptance and execution of good production practices should make possible yields approaching the so far elusive average of 15 tons per acre for Maine producers.

Sugar Beets vs. Potatoes--A Long-Term View

Aroostook County farmers are primarily potato producers. During 1966-69, many tried sugar beets, only to be discouraged with the results. Not only were yields low and returns poor; payment was slow, and in the last year of operation, payment was not forthcoming. Not until 1973 was a substantial part of the payment made on the 1969 crop.

Vexing as these problems have been, they must not be allowed to obscure the potential for returns over the longer run. Potatoes also have had years with poor and marginal prices leading to poor returns to growers.

For instance, seasonal average prices for potatoes have varied from $1.13 to $4.10 per hundredweight over the last 13 years, but only in 4 years--1964, 1965, 1969 and 1972--did they exceed $2. (Prices in 1973 will exceed those of 1972). A University of Maine study of 120 potato farms in 1968 shows total costs, including the costs of packing, exceeding gross returns for potatoes by an average of $28 per acre 4 . Potato prices were $1.85 per hundredweight in 1968, a price exceeded in only 5 of the last 13 years.

These price variations together with fluctuations in yields, make it difficult to assure an adequate income to the specialized potato farm each year. Within-season price variations further complicate producers' problems in attaining an adequate income.

In contrast, prices received for sugar beets have been relatively stable in all production areas. Regulation of the sugar supply under provisions of the U.S. Sugar Act has stabilized sugar prices. Thus, sugar beets are a potentially stable source of profits, dependent upon growers' ability to produce yields approaching the national average.

Costs and Returns for Producing Sugar Beets in Maine

Estimated costs and returns for producing sugar beets in Maine are shown in table 2. Production practices assumed here represent current technology. Recommended production practices are presented in the appendix. Estimated costs are for 1973. Inflationary pressures will most likely push prices up on all fronts, affecting both costs and returns during 1974.

Table 2--Estimated costs of growing and harvesting sugar beets in Maine, 1973

Cost items	Practice	Cost per acre
Direct costs:		
Seed	6-inch spacing, 24-inch rows, 1.5 pounds Monohill @ $5.56/pound	$ 8.35
Lime	2 tons average (assuming application of 5 tons year 1, 2 tons year 2, 1 ton years 3, 4, and 5) using locally produced marl lime @ $13.50/ton	27.00
Fertilizer	1,000 pounds 10-15-15+0.25B @ $87.50/ton	43.75

(continued)

Table 2 (continued)

Cost items	Practice	Cost per acre
Direct costs:		
Herbicides	Ro-Neet preplant 4 pounds/acre @ $23.75/gallon	15.80
	Pyramin pre-emergence (assuming broadcast application years 1 and 2 and banded application in years 3, 4, and 5) 3.5 pounds/acre @ $5.70/pound broadcast, and third that amount banded	12.00
Insecticides	Dylox 20 ozs. of 80 percent material/acre, airplane-applied	2.00
Soil analysis		1.00
Association dues	15 ton/15¢	2.25
Labor-hand	Zero hand labor assumed practical (possibly once over) 2 acres/hour @ $2.50/hour	1.25
Labor-machine	Land preparation, planting, spraying, cultivating, harvesting 9.4/hours @ $2.50 (see appendix table 1 - man and tractor time)	23.50
Gas and oil for above operations	6.4 hours @ $2.33	14.95
Repairs		6.00
Hauling	Assuming 20-mile haul @ 6¢/ton-mile and 15 tons/acre 1/	18.00
Interest	On production expenses of $141.25 2/	5.65
Specialized equipment costs 3/	Assuming a 1/3 or 1/2 share in terms of equipment adequate for a 35-acre sugar beet planting--(see appendix table 2--specialized farm machinery)	27.28
Total direct costs		$208.78

Footnotes at end of table. (continued)

Table 2 (continued)

Cost items	Practice	Cost per acre
Indirect costs:		
Land	Taxes $200 @ 22 mills	4.40
	Interest $200 @ 8 percent	16.00
Tractor and other general machinery		17.21
Overhead	6 percent of direct costs, exclusive of machinery costs	10.36
Total indirect costs		47.97
Total costs		$256.75
Gross returns:	Yield per acre assumed 15 tons--16 percent beets. Price per ton $23.64 (see appendix table 3--estimated price for sugar beets)	$354.60
Net return after all costs		$97.85
Net return after direct costs only		$145.82

1/ Hauling will be a highly variable cost, depending on the distance from farm to sugar plant.

2/ Interest is calculated at 8 percent for 6 months on expenditures for lime, fertilizer, herbicides, insecticides, labor, gas, and oil.

3/ One alternative to purchasing specialized sugar beet equipment would be using the services of a custom operator. The following data provide some indication of per acre costs for two major operations:

Custom work:	Rates per acre
Planting	$10.00
Harvesting	35.00
	$45.00
Less:	
Wages farmers would pay for these operations	-$14.05
Gasoline farmers would use for these operations	- 7.48
Net cost of custom operation	$23.47

See the text discussion of the advantages and limitations of using custom operators. See also the text discussion about the availability of used machinery now stored at the sugar beet plant in Easton, Maine.

Wholesale sugar beet prices rose through most of 1973. Prices of production supplies and machinery have increased, with 1974 prices for many items uncertain.

These estimates include all costs a grower would expect to encounter in a sugar beet operation. Although other methods of estimating costs have merit, charging the beet enterprise with its full share of all farm-production costs approaches a maximum-cost outlook.

With the profitability of sugar beet production the basic question, the inclusion of all costs is fully justified; however, some costs so included do not necessarily represent out-of-pocket costs. For instance, most indirect costs indicated here would occur for the farmer without the addition of a sugar beet operation. An item such as interest on land investment may more nearly represent an opportunity cost than an out-of-pocket expense. An opportunity cost represents the return a grower could expect from alternative investment opportunities. Among the direct costs, interest shown for production expenses and specialized sugar beet machinery may also be considered more opportunity cost than out-of-pocket expense.

Specific Cost Items

Costs shown for lime and herbicides reflect 5-year averages. First- and second-year applications will most likely be considerably heavier than in succeeding years. In a more refined analysis of costs, such initial applications might be considered as capital improvements to land. However, the averages shown here provide a more adequate reflection of expected costs than would initial expenses.

Specialized sugar beet equipment costs are shown for four items--planter, cultivator, defoliator, and harvester. If a fertilizer spreader-broadcaster and sprayer were added to these items, costs would increase almost $5. It was assumed that this equipment would service 105 acres of beets, or the equivalent of three 35-acre plots. To cut costs and assure efficient use, three growers could share this equipment, with the possible exception of a planter, which two growers would share to assure meeting the critical time requirements of planting operations. These costs are developed in appendix table 2.

An alternative to purchasing this machinery would be hiring a custom operator. Estimates were developed for two operations, planting and harvesting, in footnote 3 of table 2. Custom planting and harvesting would supply the two most important machinery needs of beet growers, but not all. Custom work may not be a good substitute for equipment ownership where considerable acreage is involved, but for small plots it may be an excellent alternative.

Although specialized machinery costs have been calculated here on the basis of it being acquired as new equipment, used equipment in good condition is

now stored at the sugar facilities in Easton. The equipment acquired by the State of Maine in the foreclosure proceedings involving MSI is estimated to be adequate for planting, cultivating, and harvesting 20,000 acres of sugar beets. This would undoubtedly become available to growers at substantially less cost than new equipment considered in this estimate. However, if the sugar factory at Easton is ever to be operated efficiently, it will require considerably more than the 20,000 acres for which used equipment is currently available. Additional equipment will most likely be priced at or above estimated 1973 prices used here.

Net Returns Per Acre

Estimated net returns per acre are shown for various yields in table 3. Yields would have to approach 11 tons per acre for a grower to break even, assuming the schedule of total costs shown in table 2. At 15 tons to the acre, net returns would be $97.85 and at 17 tons, $145.13 (table 3).

If a grower assumes indirect costs involved in producing sugar beets are covered by other farm enterprises, such as his potato operation, the sugar beet operation would break even with yields approaching 9 tons per acre, assuming the schedule of direct costs shown in table 2. Assuming direct costs only, 15 tons per acre would produce a net return of $145.82.

However, growers should be cautioned against any long-term acceptance of the proposition that a sugar beet operation need not be concerned with indirect costs.

Table 3--Per acre net returns from 16-percent sugar beets at the estimated price of $23.64 per ton, 1973 1/

Sugar beets produced per acre	Net returns per acre	
	After direct cost only	After all costs
Tons	Dollars	Dollars
8	(19.66)	(67.63)
9	3.89	(43.99)
10	27.62	(20.35)
11	51.26	3.29
12	74.90	26.93
13	98.54	50.57
14	122.18	74.21
15	145.82	97.85
16	169.46	121.49
17	193.10	145.13
18	216.74	168.77
19	240.38	192.41
20	264.02	216.05

1/ A change of 1 percent in the sugar content of beets would produce a corresponding change of about $1.14 cents per ton of beets or about $17.10 in returns at 15 tons per acre.

Growers' Attitudes

Growers' attitudes toward sugar beet production will have a major role in any future sugar industry activity in Maine. Some of these attitudes and their importance to production decisions have already been discussed in this report, but further analysis of grower reactions is in order.

In August 1971, the Maine Sugar Beet Growers Association and the Maine Potato Council joined in mailing out nearly 1,700 questionnaires to Maine potato growers in an attempt to evaluate farmer interest in the future growing of sugar beets. The questionnaire asked the following:

(1) Do you believe sugar beets can be grown profitably in Maine?

(2) Would you grow sugar beets under a reputable management structure that would guarantee payment for beets delivered?

(3) If yes, how many acres?

Growers were also asked to "please give us any constructive thoughts you may have."

A total of 509 or about 30 percent of the questionnaires were returned. Some 356, or 70 percent of the farmers returning questionnaires believed sugar beets could be grown profitably in Maine. More than 240 further indicated a willingness to grow beets, with 215 estimating they would grow 9,465 to 11,055 acres.

A limited analysis of growers' comments was made in 1971 to determine how many growers had cited compelling reasons for not showing interest in future beet production. About 50 growers were retiring, had insufficient acreage, or had some other reason for their lack of interest.

In preparing this report, the comments on these questionnaires were further examined. More than 250, or about half of the returned questionnaires had some remarks. Some were brief and others included a number of observations. These were tabulated into four general categories--production practices, financial considerations, justification for not growing beets, and other considerations. More specific categories under these general headings, and the number of growers commenting, show the extent of grower awareness and concern for sugar beet problems (appendix table 4).

Comments show that the group as a whole understands the many problems associated with sugar beet production. However, some individual farmers did not share this broad understanding of production problems, their comments implying that an answer to one particular problem would set the industry straight.

From those who believe beets can be grown profitably in Maine came comments of a more positive nature, indications of a more general need for qualified

and timely production advice and for new beginnings to be both small and well executed. Yet there was a good measure of agreement in the specific comments made, despite differences in views on the profitability of growing beets in Maine. The stress on weed control, suitable seed varieties, soil liming, and capital requirements for production are examples of this agreement. All indications point to growers' awareness of problems and their willingness to accept the guidance of well-qualified advisors.

SUGAR REFINERY COSTS AND RETURNS

Cost estimates for operating the refinery at Easton, Maine, are difficult to establish. Operating costs during 1966-69 were not available for analysis, but had they been, they might have reflected more on the many problems of initial operation, associated farm production failures, beet purchase, assembly, and handling problems than on plant operations.

Costs could be estimated from engineering data which set out fuel, power, and labor requirements. Some information of this type has been developed by a prospective refinery purchaser, but has not been available for preparation of this report. Furthermore, it is anticipated that costs will be affected by important changes in plant access to power, steam, water, and sewer facilities. Access will perhaps require changes not yet fully determined. These utilities were formerly furnished by the adjoining potato processing facility owned by Vahlsing, Inc.

For purposes of this report, costs of operating a sugar refinery of the size and type located in Easton, Maine, can be evaluated, using synthesized data developed in an economic analysis of proposed effluent guidelines for the beet-sugar industry and the cane-sugar refining industry prepared for the U.S. Environmental Protection Agency [2, 3]. These data were synthesized from a number of sources and thus minimize plant-to-plant cost variations, which can be extensive. They reflect prices and costs that were effective through a part of early 1973, and represent relationships important to an understanding of operating limitations. They do not, however, constitute an estimate of cost and return relationships for the Easton refinery and should not be considered as such.

Important in these relationships are the high direct costs relative to indirect costs. For instance, direct costs represent nearly 83 percent of the sales value of refined beet sugar and by-products produced (table 4). Beet purchase and assembly account for 55 percent of those costs and marketing accounts for 15 percent. Indirect costs, on the other hand, account for 12 percent of sales, with depreciation and interest on investment representing less than 4 percent.

Income before taxes represents 5 percent of sales. However, return on investment may be a better measure of profits, and for this model is estimated at about double the return on sales, or about 10 percent.

Table 4--Estimated sales, expenses and before-tax income per hundredweight of refined beet sugar produced, large model plant (3,900 tons slicing capacity) operating 145 days and having no flume recirculation in place, 1972 1/.

Item	Dollars per hundredweight	Percent of total sales
Sales:		
Sugar	12.15	90.9
Pulp and molasses	1.22	9.1
Total	13.37	100.0
Direct costs:		
Beet purchase	6.60	49.4
Beet assembly	.81	6.0
Production and related labor	.61	4.6
Limestone	.08	.6
Fuel	.54	4.0
Power and water	.32	2.4
Other supplies	.12	.9
Marketing	2.00	15.0
Total	11.08	82.9
Indirect costs:		
Property taxes and insurance	.21	1.6
Repairs and maintenance	.43	3.2
General administrative	.47	3.5
Subtotal	1.11	8.3
Depreciation	.36	2.7
Interest	.14	1.0
Subtotal	.50	3.7
Total	12.69	94.9
Before-tax income	.68	5.1

1/ Unlike this model, the Easton refinery is of advanced design and has some recirculation capabilities. These would require some upward adjustment, however small, in power, maintenance, depreciation, and interest costs.

Source: David, Milton L. and Buzenberg, Robert J., Economic Analysis of Proposed Effluent Guidelines--Beet Sugar Industry, U.S. Environmental Protection Agency, Washington, D.C., April 1973.

For cane-sugar refining, data are shown for two model rural plants, one small and one large (table 5). The Easton refinery, with a capacity of 700 tons per day of raw cane sugar, falls between these models with respect to input capacity. These costs are extremely consolidated, but show essential relationships.

Table 5--Estimated sales, expenses, and before-tax income per hundredweight refined cane sugar produced, small and large rural model plants (400 and 1,200 tons per day input) operating 250 days, 1972

Item	Small plant		Large plant	
	Dollars per hundredweight	Percent	Dollars per hundredweight	Percent
Sales	11.95	100.0	12.04	100.0
Costs:				
Raw sugar	9.04	75.6	9.09	75.5
Other costs	2.45	20.5	2.57	21.4
Depreciation	.09	.8	.10	.8
Interest	.14	1.2	.10	.8
Total	11.72	98.1	11.86	98.5
Before-tax income	.23	1.9	.18	1.5

Source: David, Milton L. and Buzenberg, Robert J., Economic Analysis of Proposed Effluent Guidelines--Cane Sugar Refining Industry, U.S. Environmental Protection Agency, Washington, D.C., 1973.

Raw sugar is a primary cost representing 75 percent of sales. Depreciation and interest account for 2 percent of sales for the small plant model and 1.6 percent of sales for the large plant sales.

Before-tax income was estimated at 1.9 percent for the small plant and 1.5 percent for the large plant. Again, return on investment was about double these levels, having been estimated at 3.2 percent for the small plant and 3.6 percent for the large plant.

Beets vs. Raw Cane

Comparison of these cost and return data for sugar beet and raw cane sugar refining show profits to be considerably better for beet sugar than for cane. This is in line with estimates made for the Easton refinery in an unpublished study. It has been repeatedly suggested by Maine interests that the refining of raw cane sugar at the Easton refinery could substantially cover overhead

costs and provide a training ground for establishing a dependable and experienced labor force, but would not add measurably to profits.

Changing Prices

The foregoing estimates of costs and returns reflect 1972 and early 1973 prices. During 1973, prices of many production inputs increased substantially. The U.S. Department of Labor's wholesale price index increased more than 10 percent for electric power, 125 percent for refined petroleum products, and almost 5 percent for industrial chemicals.

In February 1973, the spot price for domestic raw cane sugar was 9.14 cents per pound. This price had reached 11.34 cents in December 1973, and 12.63 cents in January 1974. It continued to rise in February, reaching 21.50 cents per pound on February 25, 1974, but fell to 17.50 cents on February 28, 1974.

Refined sugar prices are responding to these price increases. By the end of February 1974, wholesale prices of refined cane sugar in 100-pound bags were quoted at 24.00 cents per pound in the Southeast and refined beet sugar was quoted at 19.70 cents per pound in the Chicago-West region.

With price fluctuations of these proportions occurring over relatively short time intervals, cost and return projections are not only difficult, but subject to the problems of obtaining reasonable accuracy.

Special Cost Considerations for the Easton Refinery

The selected model plant cost and return data shown in tables 4 and 5 represent general relationships. They should not be expected to fit specific situations found in any refinery, including the facility at Easton.

For instance, the Easton refinery has both raw-cane and beet-sugar refining capabilities, a combination which suggests cost situations not present in single-function sugar refineries, such as those for which costs are synthesized in tables 4 and 5.

Perhaps more important are the known variations existing in costs of the various refineries from which the data were derived to build the simulated costs and return models. These cost variations ultimately affect the profitability of the refineries and are largely a function of "management and the philosophy of management that has been pursued over the years." [3, p. II-4]

Transportation Costs

New management for the Easton refinery would be expected to seek to operate on the low side of average costs, but this will be difficult in such areas as

transportation. For raw cane sugar, inbound rail transportation costs from Searsport to Easton will represent an expense not normally encountered by cane-sugar refineries, most of which are located at deep-water ports serving highly populated areas. Outbound transportation costs for refined sugar produced in Easton will reflect the distance from urban market centers.

Marketing Costs

Marketing costs are a substantial 15 percent of sales, as shown in the sugar beet cost model used here (table 4). As a new market entry, the Easton refinery might be expected to encounter higher than average sales costs, particularly in the form of price discounts that might be necessary to attract new customers.

A study of MSI operations estimated then-existing markets available to the Easton refinery to be large enough to absorb output without substantial price concessions. Distribution of sugar to these markets has continued at about 1969 levels, increasing slightly.

Recent developments in the sugar industry could ease the entry of the Easton refinery into the New England market and reduce its marketing costs. First, U.S. sugar supplies were somewhat lower in January 1974 than in January 1973. Second, a long-established New England cane-sugar refinery, Revere Sugar Refinery, Charlestown, Massachusetts, ceased operation at the end of February 1974. This facility had a 1,200-ton-per-day capacity for raw cane, compared with the 700 tons per day of the Easton refinery. If the Easton facility could be placed in operation in sufficient time to capitalize on these market conditions, its marketing costs, particularly those associated with market entry, could be lowered substantially.

Investment Costs

The Easton refinery has been available to any qualified buyer at a fraction of its original cost. To qualify, a buyer must have the resources to operate the plant in the interest of farmers and the community, because the State of Maine is more interested in community development than immediate recovery of its losses.

This has been interpreted to mean the Easton refinery has a potentially low fixed capital cost. It is contended that this would place a potential buyer in a good position to renovate the plant and make any necessary improvements to the facility, such as those required to meet new pollution control measures. And furthermore, it would better management's position in obtaining working capital.

Advantageous as such an investment situation might appear, its cost in terms of interest paid would probably exceed the 1 percent of sales indicated in

the model plant costs used here. Interest in these models represents the cost of capital in well-established older plants with fewer requirements for borrowed capital than would be expected in a newly established refining enterprise. Although interest costs would exceed those shown in the model plant costs, the basic relationship of high direct costs relative to indirect costs would remain essentially unchanged.

Feasibility of Operating the Easton Refinery

Feasibility of operating the Easton refinery depends heavily on the success growers develop in producing sugar beets. Although the refinery has cane-sugar capabilities, it is essentially a sugar beet plant. As pointed out elsewhere in this report, profits from refining beets are considerably better than for refining cane sugar. Feasibility then, should be considered primarily on the basis of beet-refining capabilities.

The refinery must be efficiently operated at or near capacity on a sustained basis that will depend on farm production of beets. It is important that sugar beet production be renewed as expeditiously as possible to achieve capacity operation for the plant. Equally, if not more important, renewed production must be carefully pursued to capitalize on the lessons learned and to avoid major mistakes encountered in 1966-69. Many observers see this as a 5- to 7-year process. In the meantime, the plant can operate on raw cane sugar, at least meeting overhead costs and providing for training inexperienced staff members.

Detailed cost data specifically applicable to the Easton refinery are unavailable for an analysis such as that presented in this report for the farm production of sugar beets. Although such an analysis could establish mathematical limits to feasibility, it would add little to the established facts that the facility is modern and technically capable of successful operation. Furthermore, a sizable market with acceptable price expectations is available.

Feasibility will also depend on management's capacity for controlling costs and pursuing marketing objectives. Prospective owners will want to keep these functions in mind as they develop management strategy.

Some assurance of feasibility can be taken from a confidential study of MSI operations in 1969. Although technical and marketing problems were then very apparent, they were believed solvable in the long run. It was the lack of a sound financial structure that was most troublesome and eventually responsible for the foreclosure proceedings against MSI. The present opportunity to acquire the Easton refinery on excellent terms should ease financial problems materially. Dedication to solving the many technical problems confronted in 1966-69 should put new management well along the way toward attaining a revitalized Maine sugar beet industry.

The idea of growers forming a cooperative to acquire and operate the Easton refinery got its start shortly after the facility closed in 1969. Although the idea has apparently lacked enthusiastic support, it has persisted down to the time this study was initiated.

A cooperative remains one of the two major alternatives, or options, that might be taken to reestablish the refinery. The other option would be a proprietary organization--either a corporation or partnership.

Each option has special problems or advantages in obtaining financing or establishing grower relations. But ultimately, the form of business organization will depend on who has the interest in operating the plant and who has the technical and financial resources to make the refinery an operating entity.

A Cooperative Organization

Forming a cooperative takes grower participation. Participation in this case means commitment to produce sugar beets and to share in raising the necessary equity capital. For instance, a recently formed sugar beet processing cooperative in Minnesota asked growers to invest $100 for each acre of sugar beets they expected to produce.

The formation of a cooperative would provide growers with two major advantages. First, it would provide them with a means for controlling the market for their sugar beet crop. Second, it would allow growers to participate in the profits realized from refining and marketing sugar.

Along with advantages, growers organizing a cooperative would be assuming responsibilities for sugar refining and marketing, including financing and obtaining the technical staff for operating and managing the refinery. These are major responsibilities, considering both the technical and financial requirements of sugar processing.

Growers assuming these responsibilities through their cooperative would have compelling commitments to produce sugar beets. This production commitment would be difficult to match under any organizational configuration that provides only for the purchase of the grower's beets, but gives him no financial stake in its operation.

A Proprietary Organization

Any proprietary organization such as a partnership or corporation that might be formed (or any existing organization) to operate the refinery would have problems very similar to those of a cooperative. Capital must be raised and

a team of technical and management specialists recruited. An existing organization might meet one or possibly both of these requirements, but a new organization of any kind would face these problems.

A major difference for the proprietary organization is lack of grower involvement. Profits go to the partners or stockholders of the business. Growers would have little or no control over the operation and no direct commitment to the organization except that gained in a marketing contract. However, the organization would need the cooperation and good will of grower relations and an effective grower contract.

Which Option?

The opportunity to form a cooperative to operate the Easton refinery has been open to growers for a long time. No evidence of enthusiasm for this option was evident during the course of this study, although some growers were encountered who indicated an interest. However, with the feasibility of growing beets unsettled in the minds of many growers, it would be unusal for organizational questions to merit much consideration. Based on extended interviews with agricultural leaders in Aroostook County and the 1971 grower survey data, interest in forming a cooperative appears to be lacking at this time.

Commitment on any substantial scale under these conditions would be difficult to attain. Although some growers have been willing to estimate acreage they might devote to sugar beet production under a favorable processing-marketing arrangement, these would have to be translated into membership contract commitments. These commitments would determine the volume of beets to be processed and provide a basis for estimating growers' contributions to the substantial equity capital that would be required to organize a cooperative.

However, many agricultural leaders contacted in the process of making this study saw no possibility that growers would raise the amount of equity capital necessary for funding a cooperative. Growers may have lost up to $1 million in the MSI foreclosure and that experience has left no reasonable expectation they would be willing to take any further investment risk in sugar refining.

A proprietary organization might have more flexibility in meeting many of these same problems. Its risks would be concentrated in the processing and marketing of sugar as distinguished from the risks growers bear in producing the sugar beet crop. Growers involved in a cooperative would bear risks in all three areas of production, processing, and marketing.

Access to venture capital could also be somewhat easier for the proprietary organization. The initial attempts to accumulate capital with which to negotiate the purchase of the refinery would probably be confined to a relatively

few participants in forming a new corporation as contrasted to a broad canvassing of growers in a new cooperative effort. If an established corporation were to become interested in purchasing the refinery, its reputation as an operating business could ease the problems of raising capital.

Advantages and limitations associated with a kind of business organization that could operate the refinery are probably less important than having a strong, dependable business as a new member of Maine's agribusiness community. The existence of an efficient and effective processing-marketing operation at the Easton refinery is probably the most important consideration for growers.

A Sugar Beet Bargaining Cooperative

Sugar beet growers in the United States are members of bargaining associations that are involved in participation contracts with refiners. These contracts vary from one organization to another, but usually the growers' final payment for sugar beets depends on the net selling price the processor receives for all sugar sold during the year and upon the sugar content of the growers' beets.

Since the sugar industry is subject to regulation under provisions of the National Sugar Program, which is administered by the Secretary of Agriculture, grower organizations and processors work together in many cases to modify the sugar program from year to year. However, nonprice bargaining may take place in several areas. Some of these include: furnishing seed; providing facilities for receiving beets; sampling, weighing, and testing beets; cultural practices; harvesting; hauling; and payment method.

The Maine Sugar Beet Growers Association (MSBGA) is a sugar-beet bargaining association. Although it has been relatively inactive since 1969, it has continued to represent growers on those occasions when sugar beets were the subject of discussion, such as in requesting the initiation of this study. It would be expected to continue to represent Maine sugar beet growers as their bargaining representative if the refinery were acquired by a proprietary organization, or it could form the nucleus for an operating cooperative should growers desire to form such an organization.

REPORT POSTSCRIPT

As this report was being prepared for publication, negotiations for the sale of the Easton refinery were continuing with the Aroostook Sugar Corporation (ASC). The tentative sale price is $3 million. Estimated plant renovation cost is $1.7 million and short term capital requirements are $5 million.

A final agreement on the sale has been delayed by the need for assurance of all approvals required by the Environmental Protection Agency for plant

operation. With the rapidly rising cost of money, these delays have made financing more difficult.

While these problems are being resolved, plans for planting small demonstration plots have been completed for two Aroostook County locations.

The formation of ASC involves Maine residents and the principals of firms that grow, handle, and ship sugar. These men will bring long experience and technical expertise in sugar operations and marketing to the new venture.

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APPENDIX

Recommended Production Practices

The recommended sugar beet production practices for Maine presented here form the technical basis for the sugar beet costs shown in the text section on costs and returns. These practices have been modified since 1969. They were made available to FCS by Dr. Paul R. Hepler, sugar-beet research specialist, University of Maine, Orono, and represent more than 8 years of research and experience working with sugar beets under Maine conditions.

Sugar Beet Production Practices for Maine

I. Select Soil - deep, high fertility, level land in cultivation and not in sod.

II. Lime - spread accurately to give a satisfactory distribution of the lime.

Tenative rates of liming for sugar beets

PH-soil test	Plow-down 1/		Harrow-in
	Pounds per acre		
6.6 and higher	0	+	1,000
5.9 - 6.5	0	+	2,000
5.6 - 5.8	0	+	4,000
5.4 - 5.5	3,000	+	3,000
5.2 - 5.3	4,000	+	4,000
4.5 - 5.1	5,000	+	5,000

1/ The so-called "Plow-down" lime should be spread, harrowed in, and then plowed-down deeply, 10 inches or more. The harrowed-in lime would then be applied and harrowed in so it will be concentrated in the top 5 inches of soil.

III. Fertilizer - 2-3-3 + B ratio of 100 lbs. of nitrogen and 2.5 pounds of boron or 1,000 lbs. of 10-15-15 - 0.25 B. applied broadcast and harrowed in.

IV. Weed control - Ro-Neet incorporated preplant at 3.5 lbs. active ingredients per acre plus Pyramin preemergence overall at 3.5 lbs. active ingredients per acre. This combination, if correctly applied, will give essentially 100-percent control of annual broadleaf and grass weeds. Cultivation may not be needed, but the grower should be equipped with a mid-mount tool bar and spider-type, spring-loaded cultivators.

(Other weed control alternatives suggested include the application of Ro-Neet as above with Pyramin in 8-inch bands or a combination of Pyramin and TCA; these treatments, though less costly to apply, will require additional and timely cultivation).

V. Seed Variety - Monohill from Hilleshog of Sweden.

VI. Planting - Plant to a stand with 24-inch rows, 6-inch seed spacing, and 3/4-inch deep on firm, but not hard seedbed. (A grower who would prefer to overplant and thin could seed at 3 to 4 inches. However, the required thinning would be costly). Some flexiplanters have a 6-inch concave zero pressure tire which mounts in front of the seed opener. Such an implement will give satisfactory firmness to the soil. In any case, it is necessary to drive slowly when planting, not over 2 miles per hour.

VII. Planting Date - Preferably by May 20, with May 31 the deadline.

VIII. Cultivation - Mid-mount tool bar with spider cultivators for close cultivation and duck feet for the middles. Precision and timely cultivation absolutely necessary following Pyramin + TCA. Cultivation is markedly reduced following Ro-Neet + Pyramin.

IX. Thinning - Not required if seed spacing is 6 inches. If a 3-4 inch spacing is used, thinning is required but should be accomplished quite rapidly.

X. Hand Weeding and Hoeing - Possibly once over following Ro-Neet and Pyramin, with 1/2 hour per acre sufficient. Probably twice, but at least once following Pyramin and TCA with a greater amount of time, possibly 2-3 hours.

XI. Insecticides -

A. One application of Dylox at 1 pound active ingredients per acre for spinach leaf miner probably is necessary. A second application may be necessary some years.

B. Green peach aphids and black bean aphids occasionally are a problem late in the season. Parathion at 1/2-pound active ingredients per acre will suffice; one application is probably sufficient, and would not be needed every year.

XII. Fungicides - not needed.

XIII. Harvesting -

A. Rotobeating
B. Scalping
C. Lifting
D. Transporting

Note: Reference to particular brands does not constitute an endorsement of the product.

Appendix Table 1--Man and tractor time per acre, Maine sugar beets, 1973

Operation	Rate	Times over	Number of men	Man-hours	Tractor hours
Plowing	2 ac./hr.	1	1	0.5	0.5
Harrowing	2.5 ac./hr.	3	1	1.2	1.2
Planting	2 ac./hr.	1	1	0.5	0.5
Spraying	5 ac./hr.	2	1	0.4	0.4
Cultivating	2 ac./hr.	2	1	1.0	1.0
Hand weeding	2 ac./hr.	1	1	0.5	-
Defoliating	2 ac./hr.	1	1	0.5	0.5
Harvesting	0.5 ac./hr.	1	2	4.0	2.0
Subtotal				8.6	6.1
Unproductive time (15 percent)				1.3	.9
Total time				9.9	7.0

Appendix Table 2--Specialized farm machinery needed to grow 105 acres of sugar beets--35 acre shares and per acre cost, 1973

Item	Price (1973)	Cost share for 35 acres	Life	Cost share/year				Cost share per acre/ year
				Principal	Interest 1/	Taxes 2/	Total	
	Dollars	Dollars	Years	Dollars	Dollars	Dollars	Dollars	Dollars
Planter- 6 row	1,900	(1/2) 3/ 950	15	63.33	38.00	10.45	111.78	3.19
Cultivator 6 row	2,750	(1/3) 917	12	76.42	36.68	10.09	123.19	3.52
Defoliator- 4 row	3,800	(1/3) 1,267	10	126.70	50.68	13.94	191.32	5.47
Harvester- 3 row	10,500	(1/3) 3,500	10	350.00	140.00	38.50	528.50	15.10
Subtotal	18,950	6,634		616.45	265.36	72.98	954.79	27.28
Fertilizer spreader- broadcaster	1,200	(1/3) 400	10	40.00	16.00	4.40	60.40	1.73
Sprayer	2,000	(1/3) 667	10	66.70	26.68	7.34	100.72	2.88
Total	22,150	7,701		723.15	308.04	84.72	1,115.91	31.89

1/ Interest is estimated at 8 percent on average investment.
2/ Taxes are estimated at 22 mills on average investment.
3/ A 1/2 ownership share is assumed for planters to provide for the critical time requirements involved in planting. All other ownership shares are 1/3.

Appendix Table 3--Maine growers' estimated price for sugar beets, 1973

Assumptions	
Refined wholesale beet-sugar price (November 1973 basis price in 100-pound bags for Northeast, not a delivery price)	13.6/lb.
Percent sugar in beets (based on weighted average at 16.3 for 1966-69 production)	16 pct.
Percent sugar recovery (based on 83.7 percent recovery in 1968 campaign)	82 pct.
Molasses - estimated for 1973 yearend, Boston, Mass.	$65/ton
- content in beets	4.85 pct.
Beet pulp - estimated for 1973 yearend, Boston, Mass.	$75/ton
- content in beets	6 pct.

Price estimate	Return per ton
Sugar:	
2,000 lbs. - 1 ton beets 1/	
.16 sugar content of beets	
320 lbs. sugar	
.82 recovery in processing	
262 lbs. sugar recovered	
.136 price per lb. refined sugar	
$35.63 return from sugar sales	$35.63
Molasses:	
2,000 lbs. - 1 ton beets	
.0485 molasses content	
97 lbs. molasses	
$.0325 price per lb.	
$ 3.15 return from molasses	$3.15
Beet Pulp:	
2,000 lbs. - 1 ton beets	
.06 pulp content	
120 lbs. beet pulp	
$.0375 price per lb.	
$ 4.50 return from beet pulp	$4.50
Total estimated return	$43.28
Growers' estimated share (1/2)	$21.64
Government payment	$2.00
Total return	$23.64

1/ This estimate of sugar beet prices does not consider the shrink of beets piled for storage prior to slicing. Shrink is related to the time beets are held in the pile and may vary 2-5 percent. Thus, shrink at Easton refinery will depend on how quickly beets can be processed.

Appendix Table 4--A summary of special comments volunteered by growers relative to production, financial, and related considerations affecting the growing of sugar beets in Maine, 1971

Subject of comment	Number of comments
Production Practices	
Weed control necessary	27
General comments--need for good practices	19
Seed variety needed for short season	15
Short season a problem	15
Well limed soil necessary	12
Machine availability a problem	10
New beginning should be small but right	10
Good soil needed	9
Production advice needed--qualified and timely	6
Planting and harvest conflict with potato operations	5
Irrigation needed	4
Transplants a short season solution	4
Zero hand labor needed	4
Thinning difficult	2
Beets need full time and attention of grower	1
Poor yields a problem	1
Financial Considerations	
Capital required for machinery and production financing	30
Subsidy needed--or special price considerations for equipment, lime, and beets	11
Payment for beets a problem	11
Pricing of beets unrealistic	7
Farmers lost too much money	5
Russet potatoes must be profitable if sugar beets are grown in same rotation	2
Justification for Disinterest in Beet Production	
Beets do not fit farm operation	72

(continued)

Appendix Table 4 (continued)

Subject of comment	Number of comments
Other	
Expressions of dissatisfaction with MSI management or with operations generally	30
Various suggestions or complaints concerning plant operations and plans to assure beet production	17
Aroostook County needs second crop	11
Farmers' need for labor	5
Beets cannot be grown in Aroostook County	4
Farmers should acquire plant and work together	3

Source: A survey of 1,700 Maine potato growers, with 509 responses, 252 with special comment, conducted by the Maine Sugar Beet Growers Association and the Maine Potato Council in 1971. Questionnaires solicited views on the profitability of growing sugar beets and also requested growers to give any constructive thoughts they might have concerning the sugar situation in Maine.

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For copies, write Farmer Cooperative Information, U.S. Department of Agriculture, Washington, D.C. 20250.

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